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Phenology of *Zagryphus zulaya* Gauld (Hymenoptera: Ichneumonidae: Tryphoninae) in a montane forest in Guatemala and a new country record for *Z. vegai* Gauld

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Abstract. Ichneumonidae are incredibly diverse, yet there have been few Guatemalan ichneumonid studies. We studied the phenology of 215 specimens of *Zagryphus zulaya* Gauld (Hymenoptera: Ichneumonidae: Tryphoninae), most captured in a light trap and two Malaise traps in a montane (1850m) forest from 2002 to 2014. One of the Malaise traps caught over 95% of the specimens. The results suggest that *Z. zulaya* is most abundant in May, June, July, and August, the rainy season. *Zagryphus vegai* Gauld is newly recorded from Guatemala; it was previously known only from Costa Rica. It was found at an altitude of 1850m, though its previous known range was 700m to 1500m.

Resumen. Los Ichneumonidae son increíblemente diversos; sin embargo, existen pocos estudios sobre los ichneumónidos de Guatemala. Estudiamos la fenología de 215 especímenes de *Zagryphus zulaya* Gauld (Hymenoptera: Ichneumonidae: Tryphoninae), la mayoría capturados en una trampa de luz y dos trampas Malaise en un bosque montano (1850m) entre 2002 y 2014. Una de las trampas Malaise capturó más del 95% de los especímenes. Los resultados sugieren que *Z. zulaya* es más abundante en mayo, junio, julio y agosto, la estación lluviosa. Reportamos por primera vez *Zagryphus vegai* Gauld, previamente conocida solo de Costa Rica, de Guatemala. La especie se encontró a 1850m de altura, aunque su rango previamente conocido era entre 700m y 1500m.

Key words. Light trap, Malaise trap, biogeography.

Introduction

Little is known of the biology of tropical ichneumonids, except for Costa Rican fauna (Veijalainen et al. 2014). The first major study on Central American Ichneumonidae was done by Cameron (1886). Most subsequent Central American studies on Ichneumonidae are from Costa Rica (Gaston and Gauld 1993; Gauld, 1988, 1991, 1997, 1998, 2000; Gauld et al. 2002a; Gauld and Janzen 1992, 2004), though there is a study of Ophioninae of Guatemala (Schuster 2012) and one of Pimplinae of coffee plantations in El Salvador (Gauld et al. 2002b).

We studied the phenology of *Zagryphus zulaya* Gauld (Tryphoninae) from 2002 to 2014 in Puerta Parada, Guatemala at 1850m altitude. This study area is a disturbed montane secondary forest dominated by *Cupressus lusitanica* Miller (cypress) with small Solanaceae trees of various species, especially *Solanum brevipedicellatum* Roe (mountain tobacco), a few *Pinus* (pines), *Ensete ventricosum* (Welwitsch) Cheesman (Ethiopian banana), *Bursera simaruba* (Linnaeus) Sargent (gumbo-limbo) and *Olmediella betschleriana* (Göpp.) Loes. (Guatemalan holly), with bushes of *Malvaviscus arboreus* Cavanilles (Turk's cap), *Fuchsia microphylla* Plumier (dolly's dress fuchsia), *Acalypha guatemalensis* Pax & Hoffmann (cancer herb), *Lobelia laxiflora* Kunth (orange toro bells), *Bomarea acutifolia* Link & Otto (yatzi), *Dahlia imperialis* Roehl ex Ortiges (bell tree dahlia), *Crusea calocephala* Candolle (wild verbena), *Heterocentron subtripplinervium* (Link and Otto) Braun and Bouché (pearl flower), *Monstera deliciosa* Liebmman (ceriman), *Smilax* sp. (greenbrier) and the Commelinaceae *Tradescantia poelliae* Hunt, *T. guatemalensis* Smith, *Tripogandra montana* Handlos, *Callisia repens* (Jacq.) L. and *Tinantia erecta* (Jacq.) Fenzl (Schuster 2012). The rainy season begins in mid-May and ends gradually in October or November.

The site has a diverse ichneumonid fauna; we have found 683 ichneumonid morphospecies here so far. In Costa Rica, the ichneumonid subfamily Tryphoninae has its highest species richness in mountainous regions, excluding *Netelia* (Gauld 1997). Species of *Zagryphus* have been found from 700 to about 1900 m altitude (Gauld 1997). The host insects of *Zagryphus* are unknown and little is known of their biology (Gauld 1997).

Gauld (1997) provided a diagnosis of *Zagryphus* Cushman 1919 and described two new species from Central America, *Z. zulaya* and *Z. vegai* Gauld. One other species, *Z. atroruber* (Townes and Townes 1945), is also known from Central America. The only other described species, *Z. nasutus* (Cresson 1868), occurs in Mexico and the U.S.A. At least 14 undescribed species occur in South America (Gauld 1997).

Aside from presenting information on distribution and phenology, we hope this paper will stimulate research on the biology of the species. For example, according to Andrew Bennett (pers. comm. 2015): “We know the hosts of only four of eleven genera of the tribe Oedemopsini. All known hosts are Lepidoptera larvae in non-woody, concealed substrates, especially leaf rolls.” We include photos of key characteristics to facilitate species determinations.

Methods

Zagryphus specimens were collected every week, primarily with a light trap (Fig. 1a) and Malaise traps, from 2002 to July 2014 at the first author’s home in Puerta Parada at km 14½ Carreterra a El Salvador, east of Guatemala City in a secondary lower montane wet forest (de la Cruz 1982). Two Malaise traps were used (Fig. 1b and 1c) set 112m apart and each surrounded by slightly different vegetation. The trap A location has *Cupressus lusitanica* and *Piper* and lacks *Pinus* and *Rhus therebinthifolia* (sal de venado). The trap B location has *Pinus* and *Rhus therebinthifolia* and lacks *Cupressus* and *Piper*, with a more open canopy and more light. Two slightly smaller light traps, separated by 4.8 m, were also run at km 22 ½ Carreterra a El Salvador, in Fraijanes municipality at 1830m from February to July, 2014 in a rather enclosed patio (Fig. 1d and 1e). The dominant vegetation there includes a tree (probably Tiliaceae), cypress, *Yucca elephantipes* (Spanish bayonet), *Dahlia imperialis* and some Solanaceae. Yellow pan traps were run for 24 hours at 1500m in Zone 2, Guatemala City in September of 2009.

Though specimens were collected every week, not all were kept or noted. *Zagryphus* was only noted every time it was collected since July, 2012. Data from previous years were taken from specimens collected and preserved in the collection of the Universidad del Valle de Guatemala, mostly from the Puerta Parada site.

Results

Of the 675 morphospecies collected since 2002 in Puerta Parada, two were *Zagryphus*: *Zagryphus vegai* (Fig. 1f) and *Z. zulaya* (Fig. 2a female and 2b male). The female of *Zagryphus* is easily recognizable by its swollen clypeus, the protrusion resembles a human nose; the male clypeus is relatively flat. *Zagryphus* specimens tend to be reddish brown with black heads and forewing lengths of 4.5 to 9.0mm (Gauld 1997). *Zagryphus* specimens were identified using the key and descriptions of Gauld (1997). *Zagryphus vegai* and *Z. atroruber* have black clypeal protrusions (Fig. 2c). *Zagryphus zulaya* females are easily identified by their red to red-brown clypeal protrusion (Fig. 2d). *Zagryphus vegai* can be distinguished from *Z. atroruber* by coarse punctures on the protrusion (Fig. 2c), whereas *Z. atroruber* has fine punctures. In addition, the scape, pedicel, and flagellomeres 1 to 4 are orange-brown in *Z. vegai* (Fig. 2e); in *Z. atroruber* the scape and pedicel are basally blackish, distally yellow and flagellomeres 1 to 2 brownish, apically yellowish and the successive flagellomeres blackish-brown. The dorsal apical margins of the last two tergites are pale yellow in *Z. vegai* (Fig. 1f) and white in *Z. atroruber*. The hind tarsus of *Z. vegai* is orange with the distal two tarsomeres infuscate (Fig. 2f), whereas *Z. atroruber* tarsomeres are white with the distal 3 infuscate (Gauld 1997). These features distinguish *Z. vegai* from *Z. atroruber*, which has a similarly swollen clypeus. Nevertheless, it is possible that we may have confused males of *Z. vegai* with those of *Z. zulaya*, but the number is probably insignificant considering the rarity of the species.

Of the three Central American species of the genus *Zagryphus*, *Z. vegai* (Gauld) was only known from Costa Rica. *Zagryphus atroruber* is known from Colombia, Ecuador, Peru and Costa Rica (Gauld 1997). We collected only six specimens of *Z. vegai*, all female, a new country and altitudinal record (1850m), previously known from 700 to 1500m (Gauld 1997). *Zagryphus zulaya* is known from 1000 to 1900m in Costa Rica, Panama and Guatemala near our collection site. Our specimens were collected between 1500 and 1850m. We collected 215 specimens: 105 males, 108 females, and two specimens of unidentified gender; 183 in Malaise traps, 26 in light traps, five in yellow pan traps and one trap unknown. Males and females were caught about equally, and the two Malaise traps were more successful than the light trap, capturing approximately seven times as many specimens. Of the 142 specimens caught from July 2012 to July 2014, Malaise trap A caught three and trap B 139.

The phenology of *Z. zulaya* is shown in Figures 3 and 4. Figure 3 shows the general phenology, displaying all data collected since 2002. Not all specimens were noted or kept in our collection before July 7, 2012; after that date all were kept. Figure 4 shows the data from July 2012 to July 2014. The trends observed between the graphs are similar. Both generally portray *Zagryphus* as abundant from May through August, common from January through April, rare in September and October, and inexistent in November and December. Figure 3 shows male *Z. zulaya* peaking in July and females in August. The abundance curve for 2013 has males peaking in May and females peaking in June. In 2014, the *Z. zulaya* collection numbers were lower than 2012 and 2013 and more were collected in March than in July, previously recorded as an abundant month. *Zagryphus vegai* was collected only in January (2), July (3) and August (1).

Discussion

Seasonal activity of *Z. zulaya* apparently peaks during May, June, July, and August in Puerta Parada, Guatemala. *Zagryphus zulaya* seems most abundant during the rainy season in Guatemala, whereas on Volcán Cacao in Costa Rica, a cloud forest habitat, it is recorded as “quite common throughout the year” (Gauld 1997). Costa Rican *Z. zulaya* are recorded for every month, but in Guatemala we did not capture a single specimen in November or December. The drier 2014 has, so far, yielded fewer *Z. zulaya* compared to the previous two wetter years. Four *Z. vegai* were collected during the middle of the rainy season, which is the peak period for *Z. zulaya*. This association weakly suggests a similar phenology for the two species, but lower abundance for *Z. vegai* or possibly less susceptibility to capture by the traps. The other two *Z. vegai* were caught in January, during which *Z. zulaya* is common but not abundant. In Costa Rica, most *Z. vegai* are collected between late March and late June (Gauld 1997). None of those collected in Guatemala were found during this time range.

The Malaise traps were more successful than the light trap, which may be due to trap location rather than type. Though there were two Malaise traps, one of them caught the vast majority of *Z. zulaya* specimens. Both are 6m Malaise traps, but trap B caught over 95 percent of the *Z. zulaya*. The difference in *Z. zulaya* catch may be due to differences in surrounding vegetation or, less likely, slight differences between traps in height of the inner wall lower margin in relation to the ground level. Other differences in Malaise trap catches noted include many more specimens of *Blepharoneura punctistigma* Norrbom and Condon (Diptera: Tephritidae) in trap A, the reverse of what occurred with *Z. zulaya*.

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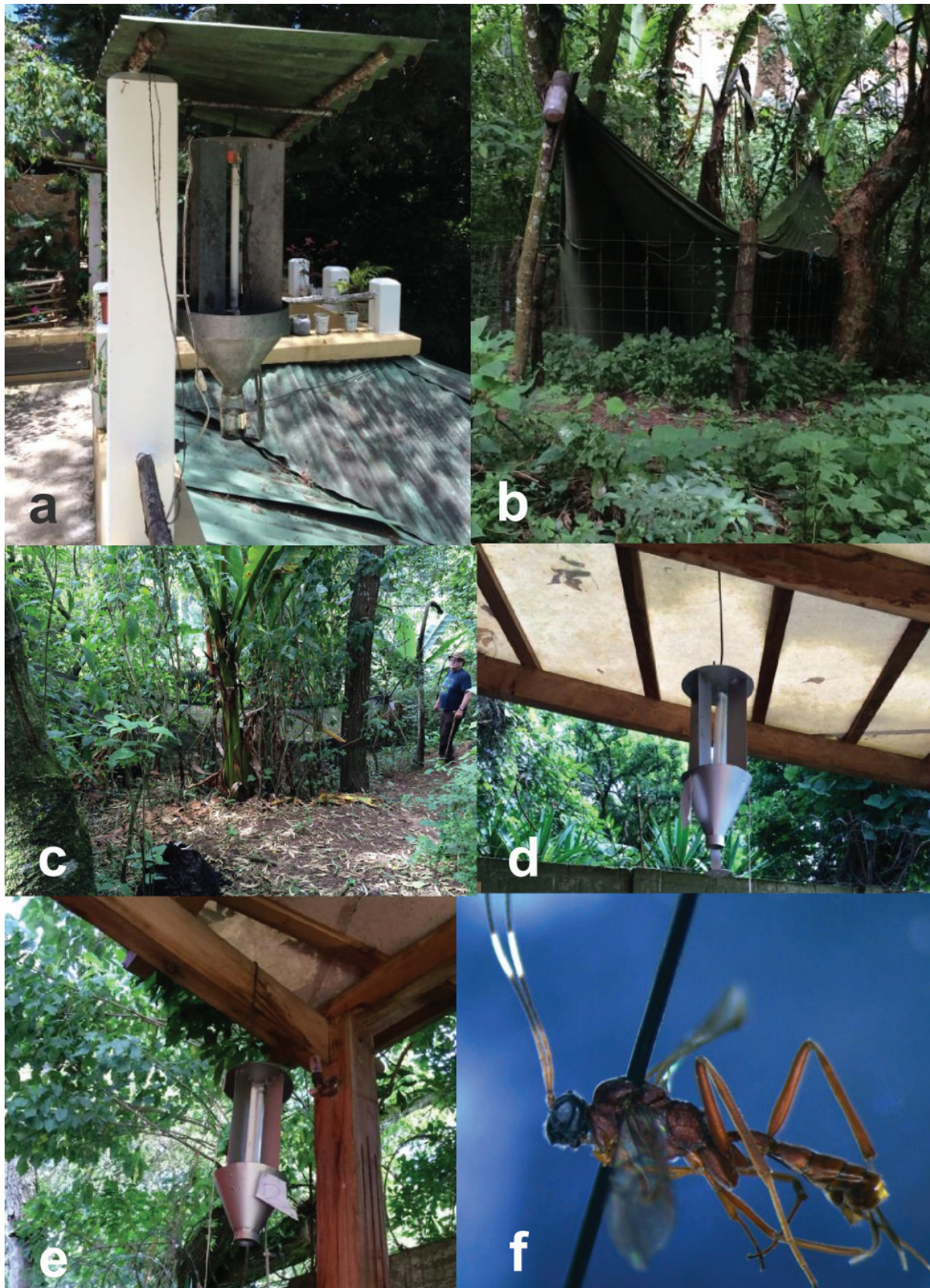


Figure 1. Traps used to collect Ichneumonidae in Guatemala. **a)** Light trap in Puerta Parada. **b–c)** Malaise traps in Puerta Parada. **d–e)** Light traps in Fraijanes, Guatemala. **f)** *Zagryphus vegai*.

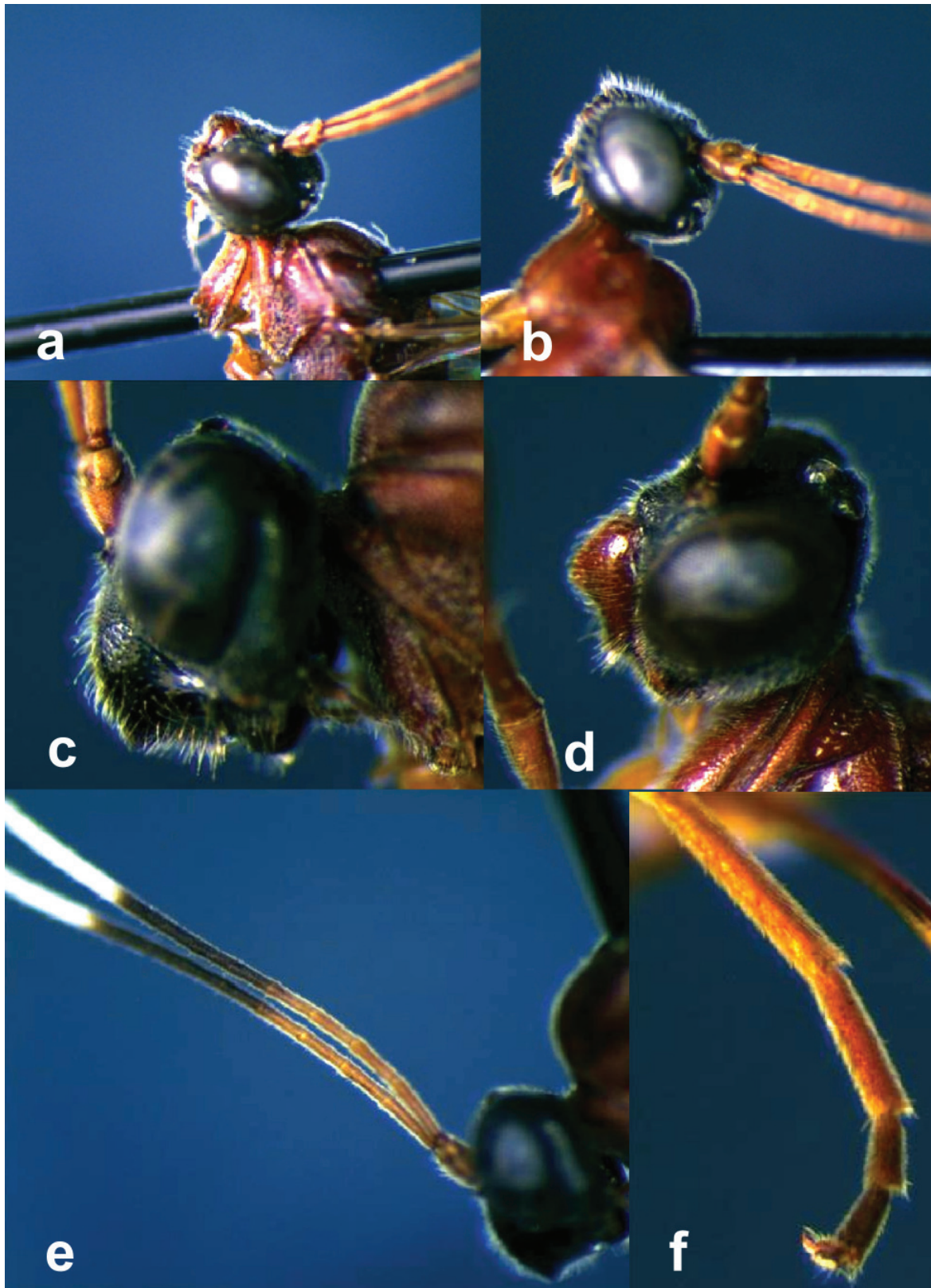


Figure 2. Morphology of *Zagryphus*. **a)** *Zagryphus zulaya* female. **b)** Male. **c)** *Zagryphus vegai* female with swollen black clypeus, **d)** *Zagryphus zulaya* female with swollen red clypeus. **e)** *Zagryphus vegai* antennae. **f)** *Zagryphus vegai* metatarsus.

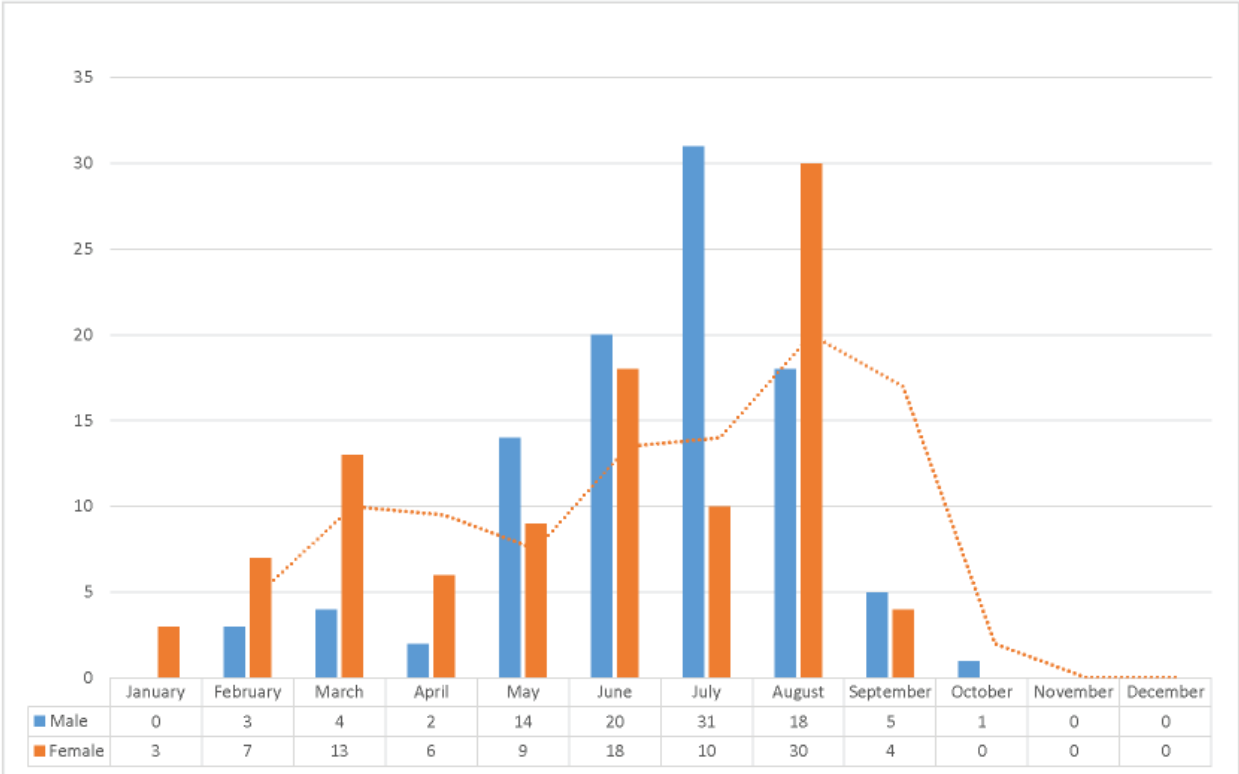


Figure 3. Phenology of *Zagryphus zulaya* in Puerta Parada using combined data from 2002 to 2014. Blue bars are males, orange bars are females.

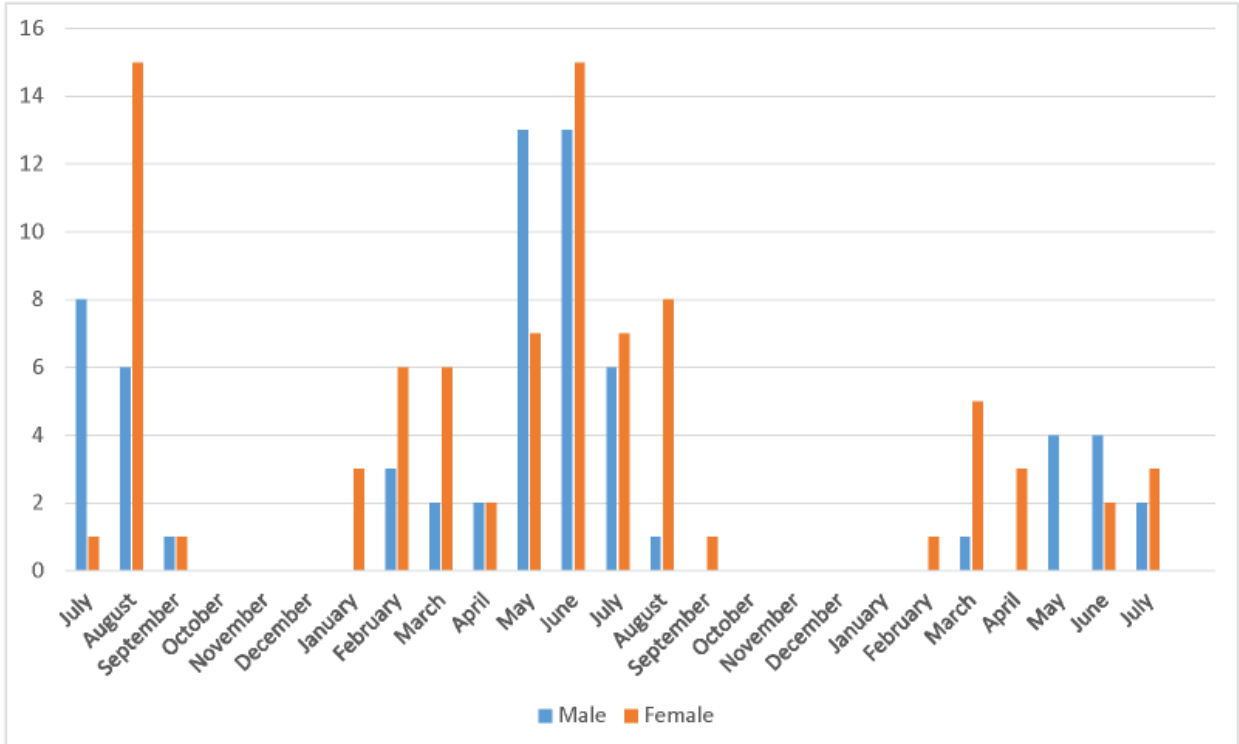


Figure 4. Phenology of *Z. zulaya* from July 2012 to July 2014.

